

MIT World (20090507) Paul E M Phillips - Monitoring Dopamine Release During Reward Learning (about lecture)

URL: <http://mitworld.mit.edu/video/709>

About the Lecture

In the process of learning, we “sometimes make more deliberative choices, and sometimes make more visceral ones,” says **Paul Phillips**. These are “semantic terms we intuitively know,” and scientists have become well-versed in creating tasks for animals and humans that demonstrate how these different kinds of learning (analytical- reflective vs. impulsive -reflexive) play out. Phillips has been trying to track dopamine release (a neurotransmitter linked to learning) in such divergent learning processes.

The model-based learning system pairs a stimulus with a reward, and after training, a subject creates a “model representation of the world” that allows it to predict the appearance of the reward after the stimulus. In contrast, the model-free system of learning “uses a one dimensional value that gets updated” as the subject accumulates experience and begins to weigh the difference between expectation and the reward that’s actually delivered.

One of Phillips’ studies involved implanting electrodes for measuring dopamine release in the striatum of rats participating in different types of learning tasks. Phillips work shows time-dependent changes in the release of dopamine during classic conditioning tasks. At first the dopamine spikes only after the reward, but over time, the animal learns it will receive the reward after the stimulus (a light cue), and soon, the cue alone elicits the dopamine response. Phillips has also found that two distinct parts of the striatum register increased dopamine at different points in the training. “This is quite interesting in terms of thinking about what these brain regions have been implicated in, and specifically the idea of habits in the dorsal striatum.”

The results of some research suggest that during these learning processes, all the dopamine neurons should be firing. But Phillips says this doesn’t explain why “we’re getting signals in (one) part of the brain but not in the other.” Phillips speculates that dopamine’s “arch nemesis acetylcholine” might be inhibiting dopamine release in certain parts of the striatum during specific phases of reinforcement learning.

Phillips has also been working with selectively bred lines of rats, which seem to exhibit behaviors, and dopamine release patterns, suggestive of two distinct learning strategies. He concludes that “associations between stimuli and rewards can be learned through multiple strategies with different computational demands,” and he doesn’t believe that animals “are locked into one strategy or another.”

Host

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Lecture Details

- Location: 46-3002

"We're interested in looking at neuroadaptation that happens over days or months, that comes about either through experience, in the case of learning, or pathology, in the case of disease."

Paul E. M. Phillips

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